

(c) Remarks

The claims are 2, 8, 14 and 15. Non-elected claims 4, 5, 7, 9, 11 and 13 are cancelled without prejudice or disclaimer. Species A, claims 1-3, 6, 8, 10 and 12 is elected. Claims 1, 3, 6, 10 and 12 are cancelled. Claim 2 is amended to better define the intended invention. Claim 8 is amended to depend from claim 2. New claims 14 and 15 are added. Reconsideration of the claims is requested.

Support for new claim 15 is found, inter alia, in Exemplary compounds 1001 and 1007 on page 29. Support for new claim 14 is found, inter alia, in Chemical Formula (13) on page 16 and in Table 1 for Compounds 1094-1110. Support for amended claim 2 is found, inter alia, on pages 40-42 and the description for Figs. 1D to 1E.

The objections to claims 1 and 3 are obviated by their cancellation.

Claims 1, 2, 6, 8, 10 and 12 were deemed anticipated by Yam, et al., especially compound 2, page 2889. Claims 1, 3, 8, 10 and 12 were rejected as anticipated by Engelhardt, et al, especially page 2859, first paragraph. The grounds of rejection are respectfully traversed.

Prior to addressing the grounds of rejection applicants wish to briefly review certain key features and advantages of the present claimed invention. The present invention provides a luminescent device comprising a luminescent layer containing a copper coordination compound of formula (2) as a guest material. The copper coordination compound has as the central metal a copper ion of plus one-valence (monovalent ion). It has been discovered by applicants that, in organic EL (electroluminescent) devices, the presence of electrodes may cause problems for a copper coordination compound having a monovalent copper ion. Specifically, when copper coordination compounds were brought into contact with an electrode, it was found that an electrochemical reaction occurred so that the valence of the copper ion, as the central metal, was changed from monovalent to divalent (Cu^{+2}). As a result, the copper coordination compound lost its property as a

luminescent (light-emission) material. To meet this problem the inventors have now provided a luminescent device designed so as not to bring the luminescent layer having a copper coordination compound as the guest material into contact with the electrodes. To separate the copper coordination compound from the electrodes the inventors employed a first organic compound layer and a second organic compound layer to sandwich the copper coordination compound and isolate it from contact with the electrodes.

Applicants utilize a copper coordination compound as a guest material, which is described in the Examples, particularly, Examples 2, 7, 8, 10 and 11. Examples 2, 7 and 8 form luminescent layers each having a thickness of 20 nm and use different concentrations (% by weight) of copper coordination compound, (Ex. 2: 10%; Ex. 7: 50%; Ex. 8: 100%). As shown in Tables 9 and 10, Examples 2, 7 and 8 achieve luminescence efficiencies (lm/w) of 14.5%, 13.2% and 12.0%, respectively. Where the copper coordination compound was a guest, in amounts of 10% and 50%, better luminescence was achieved from when it was present as the sole compound (100%).

Examples 10 and 11 form luminescent layers each having a thickness of 20 nm and use different concentrations (% by weight) of copper coordination compound, (Ex. 10: 10%; Ex. 11: 100%). As shown in Table 11, Examples 10 and 11 achieve luminescence efficiencies of 11.0% and 8.2%, respectively. The organic EL device (Ex. 10) in which the copper coordination compound in the luminescent layer is in a concentration of 10% exhibited the higher luminescence efficiency.

It is, therefore, demonstrated that organic EL devices using the copper coordination compound of formula (2) as a guest material produce unexpectedly superior results.

It is not yet fully understood just why luminescence efficiency is improved by using the instant copper coordination compounds as a guest material. However, the inventors believe that when the luminescent layer is composed of only of the copper

coordination compound, electrons and holes supplied are directly supplied to the copper coordination compound. Consequently, an ionization reaction such as anionization or cationization occurs in the copper coordination compound, so that the structure of the copper coordination compound is broken and the copper changes from a luminescent monovalent compound to a non-luminescent divalent copper compound.

As noted above, the copper coordination compound is not luminous when the copper ion is divalent (Cu^{+2}).

In the luminescent device of the present invention, since the copper coordination compound having, as the central metal, a monovalent copper ion is present in a host material as a guest material, then electrons and holes can be prevented from being supplied directly to the monovalent copper coordination compound. The copper coordination compound of this invention is luminous because the copper remains monovalent (Cu^{+}).

With regard to the art rejection, Yam discloses a compound of formula 2 on page 2889. However, there is no disclosure or suggestion of a luminescent device having the copper compound sandwiched between organic compound layers to shield it from direct contact with the electrodes. There is no guest-host light-emitting layer. Yam does not even suggest the application of his compounds to organic EL devices.

Yam's Table 1 on page 2890 indicates the luminescence (emission) wavelength (λ/nm) and luminescence (emission) lifetime ($\tau_0/\mu\text{s}$) of Complex 2. There are shown emission properties of Complex 2 both in its solid state and in a solution.

While Yam does not mention specific conditions for measuring the emission (luminescence) properties of Complex 2, it is reasonable to infer that when the emission properties of Complex 2 in the solid state and in solution are measured under the same conditions, then photoluminescence is observed. That is; Yam observes the compound's emission properties by exposing the compound to light. Yam does not

disclose measuring the emission properties by applying a voltage to a sample with the electrodes in contact with the sample.

Accordingly, although Yam discloses data for the emission properties of Complex 2 in the solid state, Yam does not disclose electroluminescence devices, wherein electrodes are brought into contact with a sandwiched light-emitting layer containing the complex as a guest. Yam fails to teach the problem solved by the present invention. It is therefore submitted that the invention is not anticipated by Yam.

Finally, Yam teaches that the emission properties of a sample, when it is contained in a liquid, are inferior to those in its bulk state. For comparison, in Table 1, the emission lifetimes are provided of a sample in a solid state, a sample in an n-hexane solution and a sample in a tetrahydrofuran solution at the same temperature (298K). The sample in the solid state has an emission lifetime of 12 ($\tau_0/\mu\text{s}$). On the other hand, the samples in the n-hexane solution and tetrahydrofuran solution have shorter emission lifetimes of 6.8 ($\tau_0/\mu\text{s}$) and 6.0 ($\tau_0/\mu\text{s}$), respectively. It is taught thereby that Complex 2 in the solid state (in the bulk state wherein it is not in some medium) exhibits superior lifetimes. Complex 2 in the liquid state, wherein it is dispersed or dissolved in some medium, exhibits inferior lifetimes. Amended claim 2 recites that the copper coordination compound is used as a guest material and is present in a host material (which is a medium for the guest). Therefore, if at all, unsatisfactory lifetimes when present as a guest, would be suggested by Yam.

With regard to Engelhard, the reference discloses compounds covered by the formulas (1) and (3) in the present application. However, those compounds are clearly distinguished from the compound represented by the formula (2) set forth in amended claim 2. Moreover, Engelhard does not refer to the emission properties of the complex nor does it disclose or suggest any luminescent device. There is no disclosure of the first

organic compound layer and the second organic compound layer sandwiching the compound as recited in amended claim 2.

The claims should be allowed and the case passed to issue.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our address given below.

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